CLAIMS

1. A reactor system comprising:

a reactor housing including an inlet portion defined therein at one end of the housing and having a discharge opening formed in the housing at an opposite end;

an air charge line connected to the housing for charging air into the inlet portion;

a steam charge line connected to the housing for charging steam into the inlet portion, and wherein the housing is constructed and arranged so that the air and steam flow through the housing from the inlet portion through the discharge opening formed at the opposite end of the housing;

a fuel injector positioned in the housing for injecting fuel into the stream of air and steam flowing through the housing;

a fuel charge line connected to the fuel injector for charging a carbon-based fuel into the fuel injector;

a catalyst bed carried in the housing and positioned downstream of the fuel injector, and wherein at least a portion of the catalyst bed includes a catalyst for promoting the reformation of the carbon-based fuel to produce hydrogen; and

an auto-ignition and carbon-suppression foam carried in the housing and positioned between the catalyst bed and the fuel injector.

2. A reactor system as set forth in claim 1 wherein the auto-ignition and carbon-suppression foam comprises a porous material having a plurality of pores formed therein with an average pore size ranging from about 10 to 40 pores per inch.

3. A reactor system as set forth in claim 2 wherein the average pore size ranges from about 10 to 20 pores per inch.

4. A reactor system as set forth in claim 2 wherein the average pore size ranges from about 20 to 30 pores per inch.

5. A reactor system as set forth in claim 2 wherein the average pore size ranges from about 30 to 40 pores per inch.

6. A reactor system as set forth in claim 1 wherein the auto-ignition and carbon-suppression foam has a void fraction ranging from about 80% to 90%.

7. A reactor system as set forth in claim 1 wherein the injector includes multiple spaced-apart holes for injecting fuel and wherein the spacing between the holes defines the injector spacing.

8. A reactor system as set forth in claim 7 wherein the pore spacing in the auto-ignition and carbon-suppression foam is at least one-tenth of the injector spacing.

9. A reactor system as set forth in claim 7 wherein the pore spacing in the auto-ignition and carbon-suppression foam ranges from about one-tenth to one-half of the injector spacing.

10. A reactor system as set forth in claim 1 wherein the auto-ignition and carbon-suppression foam comprises zirconia.

11. A reactor system as set forth in claim 1 wherein the auto-ignition and carbon-suppression foam comprises alumina.

12. A reactor system as set forth in claim 1 further comprising a catalyst agent supported by the foam for suppressing auto-ignition of the fuel.

13. A reactor system as set forth in claim 12 wherein the agent comprises lead.

14. A reactor system as set forth in claim 12 wherein the agent comprises lead oxide.

15. A reactor system as set forth in claim 12 wherein the agent comprises lead molybdate.

16. A reactor system as set forth in claim 12 wherein the agent comprises gold.

17. A reactor system as set forth in claim 1 wherein the fuel injector is positioned in the housing to allow mixing of the fuel, air and steam without reacting before contacting the catalyst bed.

18. A reactor system as set forth in claim 1 wherein the catalyst bed includes a first portion having a catalyst to promote the partial oxidation of the carbon-based fuel, and further including a second portion having a catalyst to promote the reformation of the carbon-based fuel to form hydrogen.

19. A reactor system as set forth in claim 18 wherein the first portion of the catalyst bed is positioned upstream of the second portion.

20. A reactor system as set forth in claim 1 wherein the auto-ignition and carbon-suppression foam includes a front face closest to the fuel injector and a rear face closest to the catalyst bed, and wherein the front face has a cross-sectional area less than the rear face.

21. A reactor system as set forth in claim 1 wherein the fuel injector comprises at least one tube traversing the cross section of the inlet portion of the housing and having a plurality of holes formed in the tube for distributing fuel therethrough.

22. A reactor system as set forth in claim 1 wherein the fuel injector comprises an injector body having an orifice formed therein and constructed and arranged to atomize the fuel exiting the injector orifice.

23. A reactor system as set forth in claim 1 wherein the catalyst bed comprises a ceramic monolith having through holes formed therein.

24. A reactor system as set forth in claim 1 wherein the catalyst bed comprises a plurality of individual support structures each having a catalyst coated thereon.

25. A reactor system as set forth in claim 1 wherein the catalyst bed comprises a plurality of catalyst pellets.

26. A reactor system as set forth in claim 1 wherein the catalyst bed comprises a plurality of substrates each having a catalyst coated thereon.

27. A reactor system as set forth in claim 26 wherein the substrates are substantially flat.

28. A reactor system as set forth in claim 1 wherein the fuel injector comprises a main body portion having an orifice defined therein and constructed and arranged to atomize the fuel flowing out of the fuel injector and into the flow path of the air and steam flowing through the housing, and wherein the auto-ignition and carbon-suppression foam includes a front face closest to the fuel injector and a rear face closest to the catalyst bed, and wherein the fuel injector is spaced a distance from front face of the auto-ignition and carbon-suppression foam to define an injector distance, and wherein the injector distance is sufficient so that the fuel flowing out of the injector covers substantially all of the front face of the auto-ignition and carbon-suppression foam.